




NAVY MANTECH

Manufacturing Technology Program

Fiscal Year 2003 Annual Report

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Executive Summary

The Navy ManTech program enables the insertion of technology for the acquisition and repair of weapons systems for the warfighter. To that end, ManTech invests in the development and maturation of the processes for manufacturing. This report provides a summary of the key activities of the Navy ManTech Program during FY03. The report is focused on eight areas:

- **Navy ManTech in Transition** presents the status of ManTech's actions in shifting to a new investment strategy to more effectively focus program resources on the most critical manufacturing needs of the Navy.
- **New Starts** provides an overview of the new projects initiated in FY03 and their relationship to the new strategy. The emphasis is on the rapid insertion of technology.
- **Transitions and Accomplishments** offers a summary of the benefits of ManTech projects completed in FY03 as well as those that achieved a major milestone. Emphasis is on the results of Rapid Response / Rapid Insertion projects.
- **Congressional Interest Programs** provides a summary of efforts funded within other ONR S&T accounts that are executed and managed by Navy ManTech to leverage the knowledge and resources for benefit to the Navy.
- **Leveraging Resources** demonstrates the benefit to Navy ManTech / Centers of Excellence (COEs) from financial and other resources received from other organizations.
- **Outreach** covers the actions of Navy ManTech and COE personnel to demonstrate the Program's benefits, share information, and develop requirements through direct interaction with current and future customers and Senior Navy Leaders.
- **Papers and Conferences** presents the FY03 technology transfer activities of Navy and COE ManTech personnel including publication of seventeen peer-reviewed papers, presentations and exhibits at numerous conferences, and publication of newsletters, reports and other ManTech related program information.
- **ManTech Program Highlights** contains activities in FY03, including ManTech's actions to become a leaner and more responsive organization. It also includes a look forward to several ManTech objectives for FY04.

FY03 has been a year of transition for Navy ManTech. A new strategy has been adopted that will more effectively focus Program resources on the most critical needs of the warfighter. The intent is to apply these resources where they will have the most impact. When fully implemented in FY04, seventy to eighty percent of Navy ManTech funding will address the needs of the most critical Navy systems early in their development cycle. In the FY03 transition year, PEO(Ships), PEO(Carriers), and J-UCAS were selected for near-term investment.

During FY03, Navy ManTech initiated a number of new starts influenced by the new strategy. In particular, one project supports PEO(Ships) for DD(X), four projects support PEO(Carriers) for CVN 21, and two projects support J-UCAS. Other new starts address critical manufacturing technology needs including those for submarines, aircraft, missiles, and the U.S. Marines. All new starts are aimed at the timely insertion of technology that will enable production of equipment for the warfighter.

ManTech projects completed in FY03, as well as those that achieved major accomplishments, include Rapid Response as well as longer-term projects. Examples of project results that have been implemented include:

- A Rapid Response project for the SEALs identified a commercial-off-the-shelf alternative connector system to address a maintenance problem on the SEAL Delivery Vehicle.
- The manufacturing capability for production quantities of CL-20 explosive for potential use in the Advanced Gun System (AGS submunition payload), Standard Missile, Low Cost Autonomous Attack System (LOCAAS), and Common Missile transitioned to industry.
- An interim accomplishment in the ongoing MMIC Flip Chip project has resulted in a fully operational, high rate foundry supporting LRIP 1 deliveries for the APG-79 AESA (Active Electronically Scanning Array) Radar for the F/A-18E/F.

The Navy ManTech Program had a successful year leveraging resources. With a total FY03 appropriation of $75.1M, Navy ManTech and its COEs benefited from an additional $98.0M (130% of appropriated funding) from other sources:

- Non-Navy ManTech Funds received by Navy COEs: $68.2M
- Cost Sharing of Navy ManTech projects by industry and other government agencies: $11.0M
- Congressional Interest Programs managed by Navy ManTech: $18.8M

The Navy ManTech Program continues as a vital element for achieving the timely and cost-effective transition of new technologies from S&T into producible materiel for the warfighter. Through its ONR staff and its COEs, ManTech provides the Navy with the resources for identifying and addressing the manufacturing needs for new weapons technologies as well as the repair and re-manufacturing of current systems. Program improvements will enhance the ManTech Program's responsiveness to Sea Power 21 and naval transformation.

Navy ManTech investments -- enabling industry to produce technologically superior systems for our warfighters

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1. Navy ManTech in Transition

The Navy ManTech Program has been supporting the technology requirements of the fleet since 1977. To this day, the focus has been on providing the manufacturing know-how to enable the implementation of technologies for the warfighter. ManTech investments that have made significant improvements in the manufacturing of Navy weapons systems range from the development of a measurement system that enabled the automated machining of submarine propellers to the application of fiber placement technology for the cost-effective manufacture of complex aerodynamic shapes implemented on the F/A-18E/F. They have included manufacturing development in the growth of large Gallium Arsenide crystals in the 1970s and 1980s to enable the use of this material in Navy electronic systems and the recent developments in metalworking and joining technologies to enable the use of commercial steels on Navy surface ships for implementation on LPD 17.

Notwithstanding the past successes, Navy ManTech has changed its investment strategy to increase its responsiveness to the evolving needs of our naval forces and to focus attention on the implementation of technology on systems for the warfighter. Using Sea Power 21 and SECNAV direction as defining guidance, the ManTech Program is implementing the Naval Integrated Systems Investment Strategy. This new strategy, when fully implemented in FY04, will ensure that ManTech's investments will aggressively address the highest priority manufacturing issues of select Navy acquisition programs. Investments will be focused on a few systems earlier in the development cycle for maximum impact. While naval weapons systems not included on the Navy ManTech investment list do have important manufacturing needs, there are insufficient resources to have maximum impact for all. This sharply focused investment strategy will ensure that technology is transitioned to those higher priority systems to benefit our warfighters.

Highlights of the strategy are:

- Ultimately 70-80% of yearly ManTech Program resources will be invested in accordance with this strategy, with the balance supporting Navy ManTech Corporate Investments including the Aging Fleet, the Shipbuilding Enterprise, and the Business Enterprise Initiatives.
- In close cooperation, the selected Program Executive Offices (PEOs), the ManTech staff, the Navy ManTech Centers of Excellence (COEs), and the key systems integrators will work together to identify and prioritize crucial manufacturing requirements to enhance successful execution of ManTech projects and the transition of the resulting technology.
- ManTech will work more closely with ONR's Future Naval Capabilities (FNCs) on requirements-driven, transition-oriented 6.3 and late stage 6.2 programs of interest to the targeted PEOs to provide expertise on the manufacturing processes needed to implement these new technologies.
- Cost leverage from platform owners and system integrators will be encouraged. For example, the CVN 21 and DD(X) program offices are providing technical and programmatic management support to ManTech projects that are addressing their needs, and, in FY04, the J-UCAS ManTech projects will be 25% cost-shared by industry.
- All ManTech projects will be evaluated on a yearly basis to ensure investments pay off and that transition opportunities remain viable.

In implementing this strategy, the ManTech program emphasizes four key elements: quick reaction / rapid insertion; joint planning and funding of projects; improved communications with the warfighter, the acquisition community, and the FNCs; and delivery of technology the customer requires when needed.

FY03 was a year of transition for the program with regard to implementing and executing this strategy. ManTech began to focus on the needs of the PEOs and selected three for near-term investments. Navy ManTech Program Officers were assigned as PEO Liaisons. Initial meetings began the process of prioritizing manufacturing technology requirements. In addition, ManTech began establishing liaisons with PEO offices for future investments.

The PEO areas selected are:

Near-Term:
PEO(Ships) – DD(X)
PEO(Carriers) – CVN 21
J-UCAS
Future:
PEO(Ships) – LPD 17 and Littoral Combat Ships (LCS)
PEO(Subs)
PEO(Tactical)
PEO(IWS)

Although, as illustrated in the following section, these selections influenced the choice of new starts in FY03, all new starts were not restricted to these areas. During FY03, we also concentrated on funding projects that could result in rapid insertion in the fleet. Areas of emphasis included: rapid fleet capability improvements, military-commercial integration, and surge / mobilization for the supply chain.

As the ManTech Integrated Systems Investment Strategy moves forward into FY04, the challenge of balancing the many important manufacturing requirements against the available resources continues.

2. New Starts

During FY03, the Navy ManTech Program initiated more than twenty-five new projects encompassing the highest priority needs of Navy weapons systems. A number of these are Rapid Response projects – quick turnaround actions aimed at rapid technology insertion to meet an immediate fleet need. Although the new strategy for ManTech outlined in the preceding section was not implemented in FY03, the New Starts, summarized in the table below, were affected by this strategic view and are presented here in relation to specific PEOs.

FY03 New Starts

Project	Background / Purpose	Navy Impact
PEO(Ships)		
Manufacturing Large Marine Structures	The current design concept for DD(X) includes large, thick, high-strength steel structures. Currently, these are welded manually which is time-consuming and results in distortion which then requires rework/repair. This project will integrate intelligent automation with optimum welding processes, consumables, and procedures to replace the manual welding of these structures.	Replacing manual welding will reduce labor hours, improve efficiency, and assure first-time quality resulting in reduced production cycle time and cost. Overall, this will reduce acquisition cost and construction periods for DD(X) and future surface combatants.
Phase II of Lean-*Pathways* (LPW) at five Northrop Grumman Ship Systems (NGSS) suppliers	Suppliers comprise up to 80% of the cost for the LPD 17. Phase I of this effort received praise from the LPD 17 Program Office and a request to continue improvements with five additional suppliers. It is cost-shared with prime contractor paying program management costs and suppliers funding their costs.	Goals include reducing supplier's product delivery time by 30 percent and cost by 25 percent with 99% error free delivery. Specific improvements expected include reduced material handling time, on-time delivery, and administrative changes to reduce lead-time.
PEO(Carriers)		
Development of Advanced Hatch, Door, and Closure Systems for CVN 21	Designs currently being considered for CVN 21 will impose significant restrictions on hatch, door, and closure systems including: reduced weight requirements, improved blast resistance, reduced maintenance and manning requirements, and improved affordability. This project is identifying, evaluating, and implementing manufacturing technologies to reduce production and life-cycle costs.	Naval Surface Warfare Center - Carderock Detachment, the Applied Research Laboratory, Pennsylvania State University, and Northrop Grumman Corporation are jointly developing and implementing improved manufacturing processes to enable the cost-effective production of these components.
Laser Welded Lightweight Panel Structure Fabrication	Preliminary designs of CVN 21 have indicated that weight will play a critical factor in meeting performance requirements. This project addresses the development of affordable manufacturing technology / commercial sources for the fabrication of lightweight, stiffened panels to replace more conventional structures.	Alternative structures that result in weight savings may provide significant benefits for meeting CVN 21 requirements. Providing the manufacturing technology for the production of these structures will enable their implementation.
Long Life Non-Skid Coatings	Extending the service life of non-skid deck coatings will substantially reduce maintenance and repair costs. The purpose is to develop manufacturing processes for a durable non-skid flight deck solution, including an integrated metallic non-skid structure, organic coatings, inorganic coatings, and hybrid inorganic and organic coating systems.	Extending the service life of the non-skid coating in areas outside of the landing area through one extra deployment will result in reduced maintenance and repair manpower and material projected to be more than $1M per carrier per deployment.
Development of Next Generation Salinity Indicating System for CVN Carriers	Current salinity systems are suffering from fouled electrodes that increase operator workloads and reduce the effectiveness of the warning system. The purpose of this project is to establish the manufacturing processes for the implementation of a new technology salinity indicating system on CVN class ships.	Implementing new salinity indicator technology will enhance system operation and improved quality of life for the watch-stander.

Project	Background / Purpose	Navy Impact
Modeling and Simulation for Carrier Construction Planning and Sequencing	Construction of an aircraft carrier requires seven years, involves over six hundred base units, and assembly of thousands of details and millions of parts. This project will provide simulation tools to increase planning process visibility, enable enlightened decisions earlier in the construction process, and drive costs down.	Reduced acquisition costs and fabrication time for nuclear-powered aircraft carriers.
Concept Exploration for CVN 21 Metalworking Technology Needs	To provide the metalworking manufacturing technology needed to support the CVN 21, this project will identify development needed in joining, forming, casting, heat treatment, metal selection, and other processes related to metalworking.	Demonstration of viable and affordable processing for metallic structures for the demanding service requirements of an aircraft carrier.
Propulsion Shaft Surface Treatment	Because of the high costs associated with dry-docking, a twelve year docking cycle is highly desirable for all of the Surface Fleet, especially the CVN 68 Class aircraft carriers. The current corrosion protection layer applied to propulsion shafts is reliable for no more than six to eight years. The objective of this project is to develop manufacturing methods for the application of an improved composite protection layer for ship main propulsion shafts that will afford corrosion protection for twelve years.	First implementation scheduled for FY04 -05 on the USS Carl Vinson, CVN 70 at Northrop Grumman Newport News. Subsequent implementations are anticipated at Navy and private shipyards for virtually all surface combatants. Principal benefit will be cost savings of $24M every 5 years resulting from reduced maintenance, repair, and replacement of propulsion shafting on surface ships. Warfighter readiness will be improved because of the 2X extended time between scheduled dry dockings.
PEO(Subs)		
AHP Copaltite Sealant Replacement Analysis Rapid Response	Testing after installation of submarine Air Induction and Diesel Exhaust (AIDE) valves is typically weeks due to high failure rates (75-100%). The current approved procedure uses a non-sealant thread compound. This project will identify replacement sealants to reduce failures.	Reduce the current final turn-out test time after installing the VH 2/4/5 valves by reduction in the failure rate to 0-10%. This should reduce testing from weeks to less than 3 days.
Composite Manufacturing Technology for Marine Impellers	Virginia Class submarine metal pump impellers are very costly as manufactured. Composite impeller feasibility has been demonstrated but a manufacturing process to enable the production is needed. The objective of this project is to provide manufacturing processes needed to produce a low-cost, high-quality composite impeller with the required geometric tolerances and acoustic performance.	The result will be reduced acquisition cost and improved manufacturing throughput time for Virginia Class submarine impellers. A cost savings of $200,000 and a five-month reduction in acquisition schedule per impeller is anticipated. Implementation is targeted for Virginia Class hull number 7 with back-fit potential to Seawolf Class impellers damaged in service.
Shipbuilding Initiative: Cluster-Based Manufacturing Through Integrated Product and Process Simulation	In existing shipbuilding operations, excessive, non-value-added time is spent in material movement, setup, and locating resources. The primary contributor to the inefficiency in the operation is the layout of the facility and the material flow into the existing work cells. The goal is to create a method by which process models can be rapidly built, assessed, and modified to re-engineer current process models of the structural assembly areas at Electric Boat (EB) and Bender Shipbuilding.	An integrated set of function and process modeling tools will help to streamline the existing structural fabrication activities at Electric Boat and Bender by evaluating alternative assembly processes and sequences. The product cells and advanced manufacturing concepts developed will dovetail with the design and construction of EB's structural fabrication facility to be operational in FY04 for Virginia Class construction.

Project	Background / Purpose	Navy Impact
Shipbuilding Initiative: Composite Manufacturing Technology for Low Cost Submarine Cover Plates	Virginia Class Submarine dihedral pod door cover plates and countermeasure tubes covers are currently manufactured from steel and must be individually fitted to the as-fabricated structure. Steel fabrication of the doubly curved covers is an "art" requiring shaping by hand with indefinite schedule and man-hour requirements. This project will develop and refine a composite processing technique for in-situ fabrication of the plates to reduce cost and schedule.	Principal benefit will be reduced acquisition cost and schedule for submarine cover plates. Cost savings of over $400,000 per shipset of covers and a 75% reduction in manufacturing time is estimated. First implementation is planned at Northrop Grumman Newport News in FY04 on the Hawaii (SSN 776), the third ship of the Virginia Class. Process will be suitable for rapid backfitting for lost or damaged cover plates on Los Angeles, Ohio, and Seawolf Class submarines.
Shipbuilding Initiative: Automated Materials Joining and Flexible Fixture Design to Support Product-Centered Structural Fabrication	Improvements in manufacturing technology are needed to lower acquisition costs of Virginia Class submarines. Product-Centered Manufacturing for structural assembly is an approach to achieving low volume, mixed-product, high value-added production. This project will develop design-for-manufacturing methods, flexible automated welding, and inspection technology for successful implementation of this concept for submarine fabrication.	Benefits to the Navy include reduced cost and lead-time for Virginia Class submarines with first implementation at General Dynamics Electric Boat. The project will reduce non-value-added time for material movement, set-up, and welding; improve material flow; improve standardization and documentation of the steel fabrication process; reduce inspection time; and improve quality and worker safety.
Shipbuilding Initiative: Virtual Reality Welder Training	Welding is the primary means of joining hulls, bulkheads, tanks, decks, piping systems, and other critical structures during the construction of Navy ships and submarines. Total welding costs are approximately $65M per submarine hull. Training costs for welders are estimated to exceed $5M per year at all domestic shipyards. Retraining and continuing education increase these costs even further due to lost time and schedule disruptions. By leveraging the current state-of-the-art, this project will demonstrate virtual reality as a viable technology to reduce the cost of welder training.	Benefit to the Navy is reduced acquisition cost for submarines resulting from reduced training costs and increased productivity. A 2% increase in welder productivity is forecast; and more highly skilled welders will produce higher quality welds, thus reducing weld repair costs. A successful virtual reality welder training unit will undoubtedly find use in vocational and trade schools throughout the country, increasing the quality of welding in domestic industry as well.
PEO(Tactical)		
Manufacturing Technology for SiC-C Composites Flaps and Seals	The F414 engine on the Navy SuperHornet (F/A-18E/F) utilizes SiC-C composite flaps and seals on the engine afterburner that are expensive due to the use of specialized materials and sophisticated time-consuming processes. The objective of this project is to reduce component cost and to increase production throughput by streamlining the SiC-C composite manufacturing process and by introducing lower cost new materials.	Principal benefit will be a cost reduction of $9,800 per engine for F414 engine exhaust and seal components. Resulting manufacturing technology will reduce production cycle time and avoid disruptions to the engine build and spare parts schedule for the F/A-18E/F. Implementation will be at Goodrich Corporation, Santa Fe Springs facility.
Aircraft Gear Superfinishing Rapid Response	Sun gears on the CH-46 are the most critical gear for the aircraft's transmission. They are currently being scrapped at a cost of over $1.0M per year due to surface defects. The purpose of this rapid response project is to determine if a superfinishing process could extend the useful life of the gears.	The importance is to save currently scrapped CH-46 Sun Gears as well as other gears on several aircraft repaired at NADEP Cherry Point and to lengthen the overhaul period of replacing these gears during the depot repair process. Cost-avoidance potential >$1.0M per year and improved readiness of the asset.

Project	Background / Purpose	Navy Impact
Affordable Integrated Structural Apertures	Aerodynamic and electronic performance gains from conformal embedded antenna designs have not materialized due to the inherent high manufacturing costs of integration into load-bearing structures. This project will develop affordable and reliable manufacturing processes for embedment fabrication and assess the process impact on structural and electrical performance.	Principal benefit will be reduced cost and reduced weight for satellite communications antenna system on the E-2C aircraft. Resulting technology will improve aircraft performance, increase time on station, and, thereby, warfighter readiness. Implementation at Northrop Grumman on the E-2C Advanced Hawkeye Aircraft #1 is scheduled for July 2006.
J-UCAS		
Concept Exploration Project for Joint-Unmanned Combat Air Systems (J-UCAS) Composites Technology Needs	The Navy plans to develop and field a new family of unmanned aerial vehicles to fulfill a variety of mission needs including long range surveillance, communications node, and deep precision strike. This project is assessing the maturity of the composites manufacturing technology for the preliminary design concepts from two competing contractor teams and identifying manufacturing processes required to enable production.	The primary benefit of the project is a maturation of the affordable airframe design/manufacturing process to a level such that it will replace conventional construction as the "proposal baseline" for the competing contractors.
Concept Exploration Project for Joint-Unmanned Combat Air Systems (J-UCAS) Metalworking Technology Needs	The Navy plans to develop and field a new family of unmanned aerial vehicles to fulfill a variety of mission needs including long range surveillance, communications node, and deep precision strike. This project will identify the enabling metalworking technologies needed for the production of the J-UCAS and will define viable metalworking technology initiatives.	This project will identify promising design concepts and related materials and manufacturing processes of significant interest to the industrial partners. This project is a key step in reducing the risks associated with applying the identified technologies to the fabrication of the J-UCAS.
PEO(IWS)		
Phase II of Lean-*Pathways* at four Boeing Stand-off Land Attack - Expanded Response (SLAM-ER) Missile Suppliers	The SLAM-ER Program has a requirement to reduce the procurement lead-time of the SLAM-ER missile to 52 weeks while maintaining or reducing costs. For this missile, much of the cost and lead-time is found in Boeing's supply base. This project is assisting four Boeing suppliers to implement a structured process, integrating defense with commercial practices.	The Phase II effort is anticipated to achieve results similar to those by the Phase I suppliers. On average, these suppliers reduced cycle time by 37%, reduced set-up time by 87%, and reduced part travel time by 83.5%. It is expected that this project will result in decreasing the lead-time of the missile from 75 weeks to 52 weeks.
Transformational Technology		
Tin Whiskers	Electrically conductive 'tin whiskers' can develop under typical operating and storage conditions on any product type that uses lead-free pure tin coatings. This known failure mode has been responsible for an estimated loss of at least $1B in satellites, missiles, and other equipment. This project will deliver a qualified technology to allow military manufacturers to dependably use some components only available with a pure tin finish.	Resulting benefit is to enable high-reliability military electronics by mitigating tin whisker risk. This will provide rapid fleet capability improvements by preventing interruption and/or stoppage of weapons system production.

Project	Background / Purpose	Navy Impact
SEAL Delivery Vehicle (SDV) Energy Storage System	The SDV is a six-man submersible swimmer transport device that operates from surface or sub-surface ships to covertly deliver SEALs into mission areas. It has a high maintenance, high life cycle cost battery system. This project will leverage manufacturing technology improvements (commercial battery monitoring electronics, maintainable packaging design, and commercial power supply to recharge the energy system) to reduce battery acquisition cost, improve energy storage capacity, and reduce overall battery maintenance while meeting or exceeding Navy and U.S. Special Operations Command needs.	Intent is to retrofit eighteen-vehicle fleet with this new energy system beginning in FY06. Through the 18-year projected life of the system, savings are estimated in excess of $12.5M. Improvements will allow the deployed teams to consist of more warfighters and a reduced number of maintainers. Use of long life, recharge-in-place system allows submarine to deploy with additional weapons systems in the space previously occupied by battery maintenance kits, battery spares, electrolyte, and battery chargers.
Technology Refresh For Navy Transformation	Because of the rapid evolution of electronics technologies, DoD weapons systems will increasingly be comprised of COTS components requiring a tailored in-service refresh strategy reflecting their different sustainment issues. This project will develop an information technology infrastructure to integrate the processes, information flows, and tools to effectively meet the Technology Refresh needs across the supply chain.	This project will reduce the time and costs associated with planning technology insertions and upgrades resulting in a Technology Refresh strategy suitable for any weapons system. Resulting tools are expected to reduce the cycle time for introducing new technologies by 25%, and reduce the O&S costs by at least 10% based on previous and current technology upgrade programs.
Marine Corps		
Advanced Amphibious Assault Vehicle (AAAV) (now the Expeditionary Fighting Vehicle) Troop Ramp	The weight of the AAAV door is excessive due to the inefficient design of the current baseline aluminum structure / SURMAX parasitic armor system. An alternate multifunctional composite system has been developed that is lighter and structurally / ballistically equivalent. This project will improve the manufacturing affordability of the alternate system by substitution of lower cost armor material, reduced part count, and a single-step fabrication processing.	Principal benefit will be reduced cost and reduced weight for the AAAV rear door / troop ramp assembly. Weight reduction of the AAAV is critical to meet the goal performance characteristics of the vehicle without a compromise to warfighter safety. Implementation will be at General Dynamics Amphibious Systems, Woodbridge, VA.
Other		
Lean-*Pathways* at five Rockwell Collins suppliers	Although the LPW process is successfully being applied with specific suppliers to primes on specific weapons systems, it has not been attempted with commodity-type suppliers. This project will assess whether LPW techniques at these suppliers can impact OEM's product cost for units for Navy weapons systems.	This project will benefit Navy and Government Customers by achieving the seamless integration of Rockwell Collins and its suppliers. The goals are: 100% quality, 100% delivery, schedule flexibility, continual cost reduction, and aggressive cycle times.
Fiber Optic Acquisition Training (Rapid Response)	Navy acquisition and program management personnel have extensive experience evaluating and procuring copper cable assemblies. The same knowledge base and experience does not exist with fiber optics. This course will give attendees an understanding of the complexities of fiber optic systems and a "lessons learned" overview.	Procurement specialists will have knowledge and experience necessary to be a "smart buyer" of fiber optic systems. This will initially be addressed to the NAVAIR community but has been requested by JSF and Army components. Primary Sponsor: F-18 Program Office.

3. Transitions and Accomplishments

Navy ManTech focuses on transitioning manufacturing technology to private and government industrial entities that manufacture and repair systems and components for the fleet. In this year's report, we are reporting the results in two areas: Rapid Response projects and standard Navy ManTech projects. The major difference is that unlike standard projects usually executed over a period of three to five years, Rapid Response efforts typically cover a period of less than twelve months from identification of the manufacturing need to completion of the project. These projects rely heavily on the expertise and capabilities of the appropriate Navy ManTech COE to rapidly insert manufacturing technology to address an immediate fleet need.

As an example of a recent Rapid Response project, consider the request from PMS-Naval Special Warfare and the NSW Detachment CSS Panama City, Florida to examine potential connector alternatives that would ease the manufacture and maintenance of the Computer Display Unit (CDU) for the MK8 Mod 1 SEAL Delivery Vehicle (SDV). The Navy ManTech COE for electronics, the Electronics Manufacturing Productivity Facility (EMPF), rapidly identified a commercial-off-the-shelf alternative connector system that meets environmental and mission requirements. This successful rapid insertion resulted in an FY03 New Start, noted in the chart in the preceding section, which is cost-shared by the SEALs. This new project is addressing a different issue, namely improvements to the battery system of the SDV that can result by leveraging existing commercial manufacturing processes to reduce battery acquisition cost, improve energy storage capacity, and reduce battery maintenance.

At times, Rapid Response projects are used to address the manufacturing needs and uncertainties surrounding new technologies. The intent is to identify technologies early in their development where ManTech may be able to make a difference. During FY03, the EMPF was called on to rapidly assess nanotechnology to determine manufacturing issues that the Navy should address to transition the technology into system applications. This emerging technology assessment was conducted in consultation with the Navy technology and acquisition communities and resulted in a maturity matrix that is being used to establish recommendations for the manufacturing capabilities needed to enable transition.

The table below summarizes the results of four FY03 Rapid Response projects.

FY03 Rapid Response / Rapid Insertion Transitions and Accomplishments

Transition / Accomplishment	Background / Purpose	Navy Importance / Relevance
Identified a COTS solution for alternative connector systems for the MK8 Mod 1 SEAL Delivery Vehicle. Implemented by NSW Detachment, CSS Panama City.	Requested by PMS-Naval Special Warfare and the NSW Detachment CSS Panama City, Fl to examine potential connector alternatives to ease manufacture and maintenance of the Computer Display Unit for the MK8 Mod 1 SEAL Delivery Vehicle. The purpose was to provide commercial connector alternatives to meet environmental and mission requirements.	Improved availability and reliability of the SEAL Delivery Vehicle through the integration of commercially available componentry. Specific benefits in system availability increase and cost avoidance are still being reported. This rapid response project is an example of Navy ManTech rapid insertion and resulted in an FY03 New Start that is cost shared by the SEALs.

Transition / Accomplishment	Background / Purpose	Navy Importance / Relevance
Landing Craft Air Cushion (LCAC) Extrusion Seal, Rub-ring, and Umbrella valve new designs have been transitioned to the Life Cycle Manager -the Coastal Systems Station Panama City, FL, for incorporation into the fleet of LCACs.	LCAC lift fan bearings and seals were experiencing a short service life, contributing to high lifecycle costs and reduced availability for the LCAC fleet at ACU-4 and ACU-5. This was a NAVSEA Top Management Attention/Top Management Issues (TMA/TMI) with "No Solution". This project purpose was to identify the cause of the LCAC Lift Fan Seal scouring and wearing on the fan shaft.	It is estimated that lifecycle savings of approximately $2.0M will be achieved by implementing the ManTech solutions provided. The result is simplified maintenance procedures, thereby enhancing readiness and availability.
Transitioned field welding repair technology for titanium to the XM777 Howitzer Project Office, the U.S. Marine Corps Logistics Base (Barstow), and Aberdeen Training School.	The titanium structure of the XM777 howitzer must be maintained in the field. Titanium weld repair procedures and trained personnel did not exist in the field or at the Marine Corps depots. The objective of this rapid response project was to support the XM777 Program Office and U.S. Marine Corps Independent Logistics Assessment Team in developing weld repair procedures for this weapon.	This project defined equipment, repair welding procedures, support facilities, and the skills necessary for successful field repair of titanium. An appropriate tool kit (e.g. equipment, procedures, filler metals, etc.) to make these repairs was identified. The probability of producing a sound weld repair has been increased, thus enabling a field repaired howitzer to return to active status more quickly.
Completed review of nanotechnology to determine manufacturing issues to enable transition. Developed maturity level matrix of the technologies for use in establishing recommendations for manufacturing capability to enable transition.	The objective of this project was to develop an investment recommendation regarding the integration of nanotechnology into Navy and DoD systems.	Nanotechnology has the potential to provide transformational performance increases in materials, sensors, and electronic componentry that will be used in Navy weapons systems. This has a pervasive impact across the Navy.

In contrast to Rapid Response projects, standard ManTech projects are focused on longer-term, more pervasive manufacturing needs, and as noted above, they are typically executed over a period of three to five years. The overall emphasis of the Navy ManTech Program remains on rapid transition. Therefore, interim insertion of technology during an on-going project is encouraged. Notable transitions and accomplishments of standard Navy ManTech projects during FY03 include:

- **A reproducible CL-20 manufacturing facility capable of producing 50,000 pounds per year was established at ATK Thiokol.** Candidates for CL-20 explosive use include Advanced Gun System (AGS) submunition payload, Standard Missile, Low Cost Autonomous Attack System (LOCAAS), and Common Missile. The use of CL-20 has the potential to make specific weapons systems 25% more lethal at a lower cost, translating into either increased mission capability, given the same number of weapons systems, or a significant cost avoidance due to fewer weapons being required to complete the same number of missions. For AGS requirements of approximately 138,600 pounds over five years, cost avoidance from FY06 through FY10 is estimated at an average of over $2.5M per year based on an expected overall reduction in the cost of CL-20 from the current average of $420 to $315 per pound.

- **A simulation-based scheduling algorithm for a new steel processing facility was transitioned to Electric Boat Corporation (EB)** enabling the optimization of the production sequence for a short horizon (2-5 days) for maximum facility productivity. EB's new $12M steel processing facility has resulted in significant average per piece man-hour reductions (actual percentage is proprietary). The scheduling model is expected to enable EB to maintain these time savings as the facility workload increases -- by maximizing the utilization of key resources (particularly the plate marking and plate cutting machines) and by minimizing bottlenecks in the material handling operations.
- **Reliably produced high strength fasteners expected to last the life of the system without mechanical or corrosion failures have transitioned to the SSN 774 Virginia Class Submarine Program Office.** These fasteners will result in reduced weight for the Virginia Class submarines, increased propulsor reliability, and reduced life-cycle costs due to reduced inspections and maintenance requirements. The Program Office has identified a cost avoidance of $220,000 per year per subsystem. Using the fasteners for five subsystems (propulsor, advanced seal delivery system, dry deck shelter, high frequency sail array, and wide aperture array) will result in a total cost avoidance of $1.1M per fielded submarine.
- **High rate foundry for MMIC flip chip now fully operational and supporting LRIP 1 deliveries for APG-79 AESA (Active Electronically Scanning Array) Radar for the F/A-18E/F.** This is an example of a transition occurring during an on-going project. A second source foundry is under development with completion scheduled in 2004, and full transition of X-Band MMIC Flip Chip Interconnect technology is scheduled for FY05. The high rate silver bump process is expected to lead to a projected $110K reduction in the APG-79 unit price. Additionally, the high rate capability will support other DoD programs that require millimeter wave chip technology interconnect technology.

A matrix with a brief overview of all of the FY03 Transitions and Accomplishments is included in the Appendix.

4. Congressional Interest Programs

In FY03, Navy ManTech received $18.8M from other ONR S&T accounts for the execution and management of eight manufacturing technology-related efforts. These efforts were managed by ManTech personnel to provide maximum benefit to Navy manufacturing and re-manufacturing as well as to augment, wherever possible, ongoing Navy ManTech projects.

As an example of this leveraging of resources, consider the results of two of these types of efforts, "Supply Chain Best Practice" and "Electronic Based Manufacturing using 3-D Printing Metalworking Technology".

- As indicated in the FY02 Navy ManTech Annual Report, the Supply Chain Best Practice project was co-funded by Navy ManTech to leverage Congressional Interest funding for the application of lean processes to the F/A-18E/F supply chain. It was managed as an element of the Supply-Chain Practices for Affordable Navy Systems (SPANS) Navy ManTech project with the objective of adapting best commercial practices in supply

chain management and applying them to the manufacturing of Navy systems. This year it is reported as one of the FY03 Transitions and Accomplishments in the Appendix.

- Electronic Based Manufacturing using 3-D Printing Metalworking Technology is a continuing Congressional Interest effort that is included under the title "Three Dimensional Printing for Manufacturing" in the table below. Although this technology has broad defense and commercial applications, it is focused on replacement parts on aging weapons systems at costs that are quantity-insensitive. In FY03, an example of an accomplishment of benefit to the Navy is the support provided to NUWC-Keyport. At their request, custom lens and tip brackets were manufactured at reduced cost and lead-time for the laser clad repair system that is used to repair the VLS launch tube.

The following table provides a brief description of the Congressional Interest Programs for FY03. Included in the table is the principal Navy application for each manufacturing project.

FY03 Congressional Interest Programs

Project	FY03 Funding ($M)	Navy Impact
Laser Cutting and Welding for Structural Shapes (CVN 21)	2.0	Cost of traditional Navy ship fabrication is high due to the widespread use of hot rolled structural shapes. Implementation of laser-fabricated structures can reduce the weight of Navy ships and improve cost and schedule. The objective of this project is to continue the development of a system capable of producing large quantities of accurate structural components in a cost-efficient manner.
Three Dimensional Printing (3DP™) for Manufacturing	3.9	DoD weapons systems are aging rapidly and reduced Original Equipment Manufacturer (OEM) support is resulting in diminishing manufacturing sources and material shortages. Many parts must be ordered in quantities greater than needed at high cost and long lead-time. This project is continuing to develop and demonstrate 3DP™ as an economical process for manufacturing limited quantities of parts for the DoD production and repair community.
Affordable Diode Array Manufacturing	2.5	The DoD requires a significant number of laser diode arrays for applications ranging from night vision illuminators, laser surveillance, and pod mounted illuminators to sources of pump radiation for advanced solid-state lasers. Current laser diode mounting techniques are time-consuming and very expensive. This project is developing and implementing an automated assembly, test, and inspection process to significantly reduce manufacturing cost.
Formable Aligned Carbon Tow (FACT®) Composites	1.0	This project is evaluating the manufacturing processes and mechanical properties of carbon fiber reinforced parts fabricated from a new family of aligned, discontinuous fibers called Formable Aligned Carbon Tow (FACT®). FACT® is an improved, aligned, discontinuous carbon fiber system that is expected to decrease the high costs associated with fabricating high performance, polymer matrix, aerospace composites. Navy transition opportunities include F/A-18E/F, F-35, and J-UCAS.
Titanium Metal Matrix Composites (TMC) for Naval Applications	2.2	Projects designed to transition TMC to production for Navy aircraft are underway in landing gear components, reaction links, and arresting hook components. This project is demonstrating the manufacturing maturity of TMC for airframes and propulsion components for use on the F-35.

Project	FY03 Funding ($M)	Navy Impact
Emerging Critical Interconnect Technology (ECIT) Program	1.0	The ECIT Program promotes the emergence, refinement, and delivery of new interconnect technologies for military electronics and encourages domestic technology development through cooperative teaming arrangements with military, industry, and academic partners. The goals include the facilitation and rapid deployment of new technology into military applications as well as providing domestic industry partners with an advantage over their global counterparts.
Lean-Pathways (LPW) Distance Learning Project	3.8	Distance learning techniques are being applied to the LPW process to expand deployment to additional suppliers critical to Navy weapons programs. An enhanced learning environment is under development to double the number of participant companies in the LPW Deployment Process and reduce the cycle to complete the LPW Distance Learning-blended Training Program by 10 percent.
Reduced Distortion in Steel Plate for LPD	2.4	Part of a comprehensive program to increase quality and throughput in the panel line operation at Northrop Grumman Ship Systems Avondale Operations. The project is focused on distortion issues associated with steel plate less than 5 mm thick, which will be used in increasing amounts on future Navy projects. Measurement systems, welding processes, stiffener sequencing, and material handling are being assessed for improvement.
Total:	**$18.8M**	

5. Leveraging the Resources of Other Organizations

a. Benefits of Leveraging

The Navy ManTech Program has a demonstrated history of results that benefit the warfighter. It has done so even though yearly requirements for manufacturing technology always exceed the available funds. To maximize the impact of these funds, every attempt is made to leverage resources of other organizations. In particular, the funding of COEs by organizations other than Navy ManTech and the cost sharing of Navy ManTech projects have the following technical and economic benefits:

- Reduces duplication of effort and promotes two-way communication by providing a mutual focus on specific ManTech issues.
- Enhances the COEs' technical expertise and national recognition.
- Expands the ManTech business enterprise permitting ManTech to do selected programs better and achieve improved results.
- Distributes the COEs' overhead costs to organizations other than Navy ManTech.

Leveraging also includes the sharing of information and technical talent with other entities. This involves interaction with the Army, Air Force, and Defense Logistics Agency (DLA) ManTech programs and other government agencies and industry on manufacturing developments through the auspices of the Joint Defense Manufacturing Technology Panel (JDMTP). Leveraging of technical expertise is also encouraged among the COEs. During FY03, a number of Navy ManTech projects have been funded that involve more than one COE to foster this interaction.

One example that highlights the benefits of leveraging is the Navy ManTech managed program on Affordable Diode Array Manufacturing (ADAM). The DoD requires a significant number of laser diode arrays for applications ranging from night vision illuminators, laser surveillance, and pod mounted illuminators to sources of pump radiation for advanced solid state lasers. The ADAM program was initially funded by the Defense Advanced Research Projects Agency (DARPA), managed by Navy ManTech, and executed at the Navy Electro-Optics Center (EOC). As a result of the initial successes in reducing the manufacturing cost of the diodes, the effort was continued in FY03 at the EOC as a Congressional Interest program. The technology is applicable to a wide range of defense products including the DARPA and Missile Defense Agency (MDA) 3-D Imaging Ladar systems and the Navy / Air Force Aircraft Targeting Pod. It has been implemented into the Army's Heat Capacity Solid State Laser (HCSSL).

b. Outside Funding to the Centers of Excellence

Outside funding (OSF) supports manufacturing projects at the COEs that are not Navy ManTech funded. The ManTech Program Office has been encouraging the COEs to proactively seek OSF, which has been increasing each year. This continuing upward trend in OSF is indicative of, and further helps to increase, the COEs' expertise. OSF also reduces the burden on Navy ManTech for support of the COEs' operations. The result is a wide range of manufacturing expertise available to the Navy. For FY03:

- As indicated in the table below, the COEs received significant outside funding, with some matching or exceeding their Navy ManTech funding.
- OSF received by all Navy COEs totaled $68.2M as compared to the FY02 outside funding of $47.8M, an increase of over 43% and an increase of 269% over FY01's OSF of $18.5M.
- The OSF amounted to 109% of the Navy ManTech funding provided to the COEs. This compares to the FY02 amount of 88%, an increase of 24%.
- The EOC received outside funding of $45.4M from several DoD organizations, representing a leveraging of 1,009%.

FY03 Outside Funding Received by COEs

COE*	Navy ManTech Funding ($M)	OSF (Non-Navy ManTech Funding) ($M)	% of ManTech Funding
BMP	3.0	3.7	123%
CMTC	10.5	0.2	2%
EMPF	10.5	1.6	15%
EMTC**	2.0	0	0
EOC	4.5	45.4	1,009%
GCRMTC	5.8	0.2	3%
iMAST	6.6	8.6	130%
NCEMT	13.5	8.2	61%
NJC	6.3	0.3	5%
Totals:	$62.7M	$68.2M	109%

* NOTE: See the Appendix for the complete name of each COE.

** Navy Lab.

Funding was distributed to the COEs through various ONR Contracts and other contract vehicles. More details on the sources of outside funding and the programs funded are presented in the Appendix.

c. Cost Sharing

Cost sharing of Navy ManTech projects, including funding and in-kind support by both industry and other government entities, is highly encouraged, and is a legislatively mandated source selection criteria for all ManTech contracts. Cost sharing leverages Navy ManTech funding to achieve technical results and, in many instances, builds in an implementation partner.

- In FY03, cost share contributions were $11M, or 18% of Navy ManTech funding.

The following table indicates the FY03 cost share by COE.

FY03 Cost Sharing of ManTech Projects

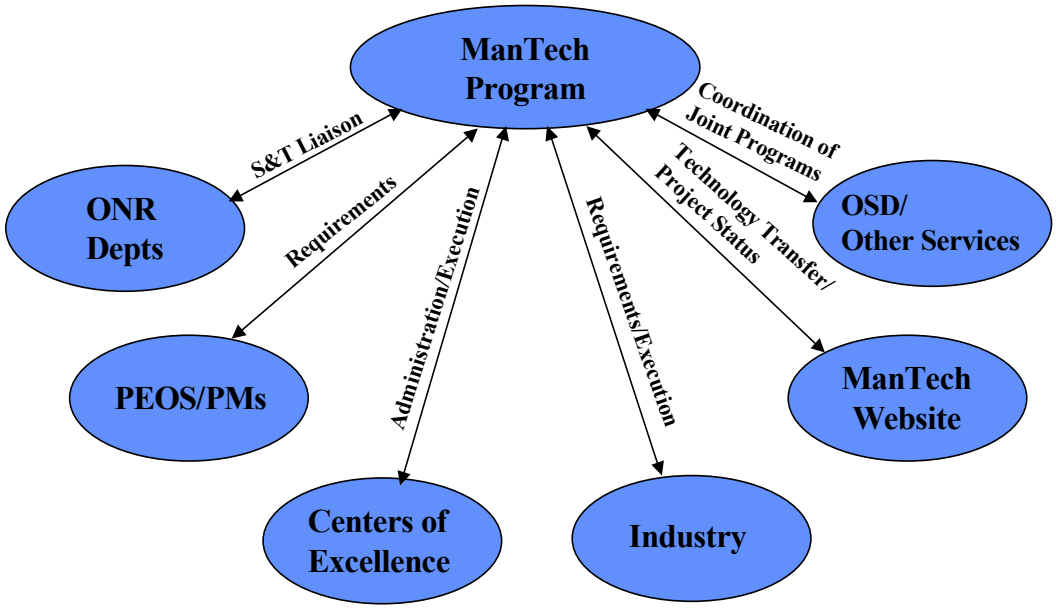
COE	Navy ManTech Funding ($M)	Cost Share ($M)	% Of ManTech Funding
BMP	3.0	0.7	2%
CMTC	10.5	1.7	16%
EMPF	10.5	2.4	23%
EMTC	2.0	0.3	15%
EOC	4.5	0.1	2%
GCRMTC	5.8	0.6	10%
iMAST	6.6	3.7	56%
NCEMT	13.5	0.2	1%
NJC	6.3	1.4	22%
Totals:	$62.7M	$11.1M	18%

6. Outreach

One of the Navy ManTech's primary responsibilities is proactively communicating with current and future customers and senior management within its chain of command. This interaction generates knowledge of all aspects of the ManTech Program, enables sharing of information, aids in developing requirements, and applies the Program's expertise in ways that are mutually beneficial to the customer and the Program. Outreach activities range from simple sidebar discussions at conferences and workshops to formal meetings with acquisition, senior leadership, and other Navy personnel. Navy ManTech Program Officers and personnel from the Navy COEs perform outreach activities.

As illustrated below, the ManTech organization interacts with key organizations to ensure that the program is concentrating its resources on the manufacturing needs of the Navy. In all cases, the focus is on the timely transition of the technology so that it can be implemented by the PEOs and PMs in their acquisition programs and in the industrial organizations that will produce these systems.

Program Outreach



a. Significant Senior Leadership Meetings

During FY03, Navy and COE ManTech personnel initiated and participated in numerous interface meetings to foster an improved understanding of Navy ManTech and our capabilities by PEOs, Program Managers (PMs), senior Navy leaders, industry, ONR personnel, and other government entities.

The following table lists a sampling of significant senior leadership meetings.

FY03 Significant Senior Leadership Meetings*

Senior Leadership	Purpose
Mr. C. Crapps, Deputy Program Manager, Standard Missile Program	Conducted and facilitated Standard Missile Program Senior Leadership Offsite and Project Status Review, Standard Missile Culture Change Initiative
RADM C. Hamilton, PEO(Ships) RADM G. Godwin, PEO(Tactical) CAPT J. Kinzer, J-UCAS S&T Program Mgr. Mr. B. Persons, Deputy PEO(Carriers) Mr. D. Marker, PEO(IWS) Ms. A. Sandel, Deputy PEO(IWS) CAPT S. Hancock, ONR Code 35	Various Meetings and briefings by Headquarters Program Officers on new ManTech investment strategy and coordination of requirements.
CDR M. Anderson, Program Manager, Standard Missile (SM-6) Program	Briefing on BMP
Mr. R. Stone, Director, Missile Defense Agency Safety, Quality and Mission Assurance	Introduction, overview, and discussions of BMP support

Senior Leadership	Purpose
Mr. A. Patel, Government Project Manager and Ms. R. Badien, Program Manager, Standard Missile-3 / Raytheon	BMP Risk Manager, Mr. C. Minter, appointed as Government lead for Mission Assurance
Brig Gen W. D. Catto, Commander, Marine Corps Systems Command	Final assessment brief for the Complementary Low Altitude Weapon System Program. Discussed support for production of Afghanistan emerging requirements.
Ms. K. Wahl, Group Director, Marine Corps Systems Command, Battle Management Air Defense Systems	Discussed hybrid electric vehicle propulsion
Mr. R. Bates, Group Director PA&E , Marine Corps Systems Command	Provided BMP capabilities brief
RADM K. Paige, Program Director, Aegis Ballistic Missile Defense	Support of on-going work efforts
RADM M. Mathis, Director, Joint Theater Air Missile Defense Organization	Ongoing technical discussions including interoperability, open systems architecture and use of Link-16 on missiles.
RADM P. Sullivan, NAVSEA	Discuss Application of Composites on Submarines
Dr. T. Tether, Director DARPA	Discuss Manufacturing Technology Initiatives
CAPT D. Schubert, Commanding Officer, NRL	Nanomaterials Discussions
Maj Gen P. Neilson, Commanding Officer, AFRL	Composites Application Discussion
Lt Gen R. Reynolds, U.S. Air Force, Wright Patterson AFB	Composites Manufacturing Technology Discussions
Dr. C. Milligan, PEO(Carriers) Technical Director	CARTECH Needs for Composite Materials
Mr. D. McClucky, Sr, VP Operations – Boeing	Create a Collaborative linkage between Boeing in support of the F/A-18E/F and the CSEL program that directly supports ManTech activities at NAVAIR.
Mr. H. Reininga, Sr, VP Operations – Rockwell	Create Collaborative Efforts Between Manufacturing Technology Investments at Rockwell and Current Investments at the Navy COE in Electronics.
Dr. M. McGrath, Deputy Assistant Secretary of the Navy for RDT&E	Briefed on the Current activities and accomplishments of the Navy ManTech COE in electronics in support of acquisition programs and the warfighter.
RADM M. Tracy, Commander Submarine Group Two	ARL ManTech Projects
Maj Gen R. Kelly, USMC, Deputy Commandant for Logistics	Brief ARL Marine Corps Programs, iMAST/REPTECH overview
Lt Gen M. Hough, USMC, HQMC	ManTech overview
ADM F. Bowman, USN, Office of the CNO	Capabilities update at Navy League Expo
RADM J. Butler, PEO(Subs)	Briefings on ARL ManTech Projects
Brig Gen T. Waldhauser, USMC, Marine Corps Warfighting Lab	ManTech overview
CAPT C. Goddard, USN, Program Manager DD(X), PMS 500	Briefing on status and future plans for composite to steel adhesive bonded joints project. Briefing resulted in endorsement for project goals and future plans.

*Note: Titles shown are positions held at the time of the meeting

b. Outreach to the S&T and FNC Community

During FY03, ManTech initiated a closer relationship with ONR's Future Naval Capabilities (FNCs) on requirements-driven, transition-oriented 6.3 and late stage 6.2 programs that fit within the new ManTech investment strategy. Often these S&T programs have promising technology in need of process advancements before transition can be achieved. Where complementary, ManTech can provide expertise in solving the process technology issues associated with the new FNC products, particularly those issues impacting product affordability and, therefore, successful transition to the fleet. The table below presents a sampling of significant outreach meetings with the S&T and FNC community.

Outreach to the S&T and FNC Community

Organization	Purpose
Mr. P. Gido, ONR, Assistant, VCNR	Briefing on BMP's S&T to Production task
Ms. L. Torres, ONR Code 36 Department Head, & Expeditionary Logistics FNC Staff Members	Demonstrated features and capabilities of BMP's Collaborative Work Environment. Define architecture for future Ground Logistics Command and Control
Dr. R. Vogelsong, ONR DD(X) S&T Coordinator	Coordination of ongoing ManTech DD(X) Programs
Dr. G. Prinz, NRL	Discussion on use of nanomaterials for lighting, EMT shielding and displays
Dr. J. Murday, ONR Chief Scientist	Discussion of nanomaterials developments
Dr. A. Nickens, Dr. Richard Carlin, ONR	Briefing on possible hydrogen fuel applications for USN underwater vehicles.
Dr. H. Deitrich, ONR	Collaboration on WBG Devices for Link-16 Power Amplifier Affordability Program
Dr. A. Webb, NRL	RF device technologies in support of Link-16 Program
Dr. T. McKenna, ONR 342, Knowledge Superiority and Assurance FNC	Coherent Analytical Computing Environment ATD
Dr. J. Christodoulou, ONR Materials Division	Review work at Navy Joining Center (NJC) and ONR to coordinate future efforts in steel materials
Dr. R. Barsoum, ONR Structures Division	Review work at NJC and ONR to coordinate future efforts
Dr. A. Perez, ONR 33; Ms. A. Kilmartin, DRPM AAAV (EFV); Mr. B. Steinheiser, GDLS TOC FNC	Support GDLS in Systems Analysis of Prognostics Design

c. Outreach through Capabilities Briefings, Workshops, and Project Reviews

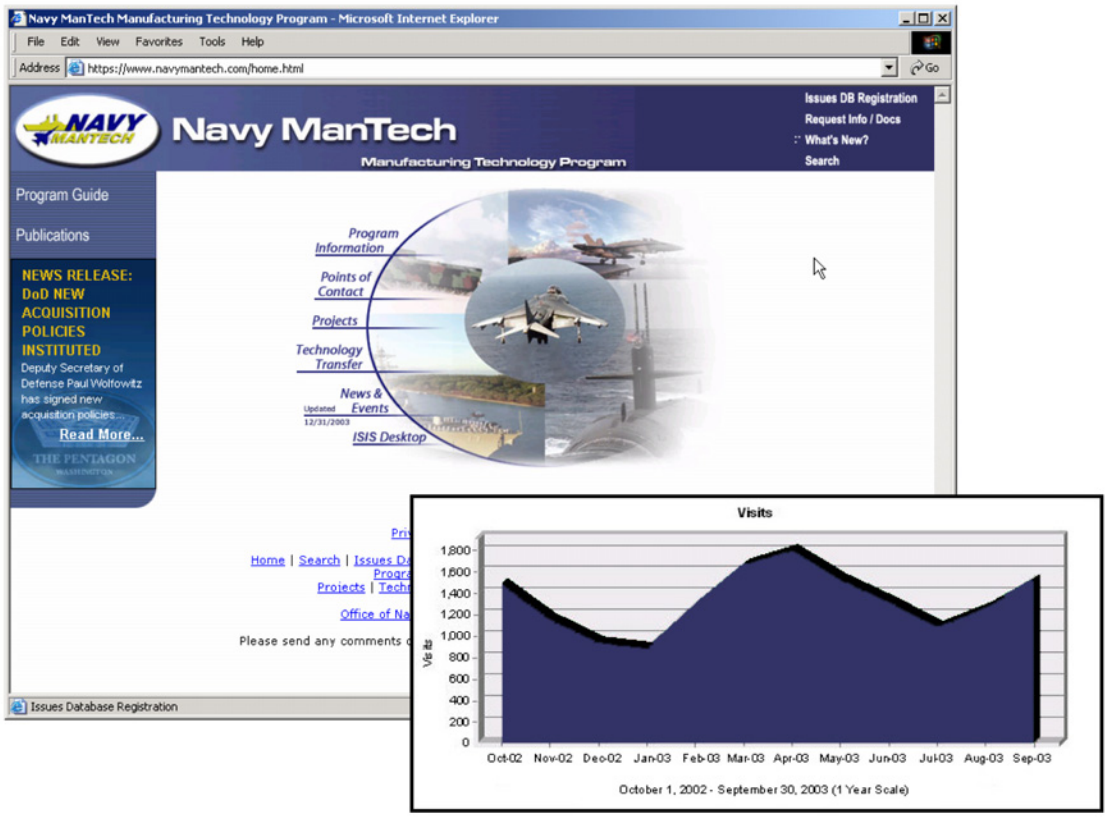
An additional method of outreach to current and future ManTech customers is conducting capabilities briefings that provide information on the technical expertise and experience residing in the COEs; conducting or attending workshops in a particular technical focus, thereby exchanging information that may generate new requirements; and conducting program reviews that provide status of ongoing projects to all interested individuals. During FY03, Navy ManTech COE personnel conducted:

- Seventy Capabilities Briefings
- Fifty-one Workshops
- Sixty-three Project Reviews

d. Utilization of Navy ManTech and Center of Excellence Web Sites

An additional mode of outreach to current and potential ManTech customers is the utilization of the Navy and COE Web sites. The Navy ManTech Web site provides users the opportunity to obtain relevant Navy ManTech Program information including the Navy ManTech investment strategy, ManTech project related information, future ManTech events (seminars, conferences, and demonstrations), proceedings from past events, COE descriptions and links, as well as key ManTech points of contact for obtaining program assistance.

- During FY03, Navy/COE Web sites received a total of 1.8M hits. This represents a 29% increase in Web site activity from FY02.
- Additionally, the DoD ManTech Web site, with links to the other Services and Navy COEs, received a total of 1.1M hits, also a substantial increase from FY02.
- The figure below illustrates the monthly Navy ManTech Web site utilization. On average, there were over 1350 verifiable visits per month.



As a result of COE Web site utilization:

- The Composites Manufacturing Technology Center (CMTC) identified two potential consortium members.
- The EMPF Web site generated 702 requests for technical publications and 846 "help line" calls, which resulted in 70 Demonstration Factory projects and 342 requests for training. These efforts produced $366K in Other Program Income that is used to support ManTech projects.
- The Gulf Coast Region Maritime Technology Center (GCRMTC) developed an on-line, Web-based peer review process that has considerably reduced the time and cost involved for evaluating new programs.

e. Training, Learning Centers and Project Demonstrations

The education of manufacturing students and employees at all levels of experience is enhanced through the training and demonstration sessions of the COEs. Through the use of teaching factories and learning centers, advances in manufacturing technology are transferred to a wide range of industry and government personnel.

- Example: The Adaptive Mechanized Welding System was successfully demonstrated by the Navy Joining Center (NJC) at General Dynamics Electric Boat Corporation in April 2003. This marked the completion of a major project task. The demonstration confirmed the ability of the real-time adaptive welding system to reliably produce multi-pass groove welds on Navy ship structures. The technology developed will reduce costs, increase reliability, and improve the quality of arc welding operations. The NJC provided three days of training on operation of the system prior to the demonstration.

During FY03, the Navy ManTech COEs conducted 141 training and demonstration sessions with 3,176 attendees.

FY03 Training and Demonstration Sessions

COE	Sessions	Attendees
BMP	14	442
CMTC	6	1010
EMPF	79	395
EOC	15	940
GCRMTC	12	254
iMAST	8	40
NCEMT	2	20
NJC	5	75
Totals:	**141**	**3,176**

7. Papers, Conferences, and Other Publications

Technology transfer is of prime importance within the ManTech Program. Hence, the Program encourages the writing of technical articles and papers, presentations at, and participation in, professional conferences, and the publication of newsletters and technical reports.

a. ManTech Articles and Papers

During FY03, COE and Navy ManTech personnel published a total of forty-nine technical papers and articles in thirty different publications including:

- The Welding Journal of the American Welding Society
- The Journal of Surface and Coatings Technology
- The Journal of Materials and Manufacturing Processes
- The Journal of Materials Science
- The Journal of Advanced Materials and Processes
- The Journal of Ship Production

The table below lists seventeen peer reviewed articles and papers.

FY03 Peer- Reviewed Articles and Papers by Navy ManTech and COE Personnel

Title	Publication	Author(s)
Nanograined Net-Shaped Fabrication of Rhenium Components by Electron Beam-Physical Vapor Deposition	Journal of Materials and Manufacturing Processes	D. E. Wolfe, J. Singh
Synthesis And Characterization of Multilayered TiC/TiB2 Multilayered Deposited by Ion Beam Assisted Electron Beam Physical Vapor Deposition (EB-PVD)	Journal of Surface and Coatings Technology, Vol. 165	D. E. Wolfe, J. Singh and K. Narasimhan
Evaluating High Powered Diode Arrays	Technical Notes from Solid State Laser Diode Review	D. Bernot, J. T. Schriempf and R. Knee
Assessing Maintenance Cost for Design or Re-design of Complex Machinery	Proceedings of the 2002 American Society of Mechanical Engineers, Design Engineering Technical Conference, Montreal, Canada, Oct. 2002	Dr. A. Butler, D. Baldwin, and M. Kashyap
Six Sigma Implementation and Best Practices in Dry docking	Proceedings of ICMES 2003, Helsinki, Finland, May 18-22, 2003	Dr. B. Inozu and I. Radovic
Six Sigma Implementation for Ship Maintenance and Safety Management	International Association of Maritime Economists Conference, Panama City, Panama, Nov 13-15, 2002	Dr. B. Inozu and I. Radovic
The Challenges of Equipment RAM Data Exchange in the Maritime Industry	Maintenance & Reliability Conference (MARCON), Knoxville, TN - May 2003	Dr. B. Inozu and P. Roy
An American Perspective on Japanese Shipbuilding Competitiveness	Techno Marine: Bulletin of the Society of Naval Architects of Japan, No. 873.	Dr. P. Koenig and Dr. H. Narita

Title	Publication	Author(s)
Shipbuilding Productivity Rates of Change in East Asia	Journal of Ship Production, Vol. 19, Number 1.	Dr. P. Koenig, Dr. H. Narita and K. Baba
Rapid Manufacturing of Rhenium Components Using EB-PVD	Journal of Rapid Prototyping	I. V. Fuke, V. V. Prabhu, S. Cho, T. George, and J. Singh
Wide Band Gap: Industrial Base Review	Defense Manufacturing Conference Proceedings	J. Perkins
The Impact Of Lead-Free Conversion on Military and Aerospace Applications	JEDEX 2003, Semiconductor Conference and Educational Classes Proceedings	C. Minter; C. Rauta, and N. Tambakis
Effect Of Gravitational Orientation on the Micro Structural Evolution of Gas Tungsten Arc Welds in an Al-4 Wt.% Cu Alloy	Journal of Materials Science, Vol. 38	N. Kang, J. Singh, and A. K. Kulkarni
Gravitational Effects on the Gas Tungsten Arc Welds of 304 Stainless Steel	Journal of Materials and Manufacturing Processes, Vol. 19, No. 5	N. Kang, J. Singh, and A. K. Kulkarni
Effect Of Gravitational Orientation on Surface Deformation and Weld Pool Geometry During Gas Tungsten Arc Welding	Journal of Materials and Manufacturing Processes, Vol. 18, No. 5	N. Kang, T. A. Mahank, A. K. Kulkarni, and J. Singh
Rapid Manufacturing of Metal Matrix Composite Materials Using Three Dimensional Printing (3DP™)	Rapid Prototyping of Materials, The Minerals, Metals, and Materials Society (2002)	R. Anderson, J. Lembo, and M. Rynerson
21st Century Surface Combatants Require Improved Composite-to-Steel Adhesive Bonds	Advanced Materials and Process Technology Information Analysis Center Quarterly, Volume 7, Number 3	J. Simler and L. Brown

b. ManTech Presentations / Participation in Conferences

During FY03, Navy and COE ManTech personnel participated in over 135 conferences and professional meetings. Ninety papers were presented at over fifty national and international conferences and symposia including the:

- ONR Navy-Industry R&D Partnership Conference
- Defense Manufacturing Conference
- International Congress on Applications of Lasers and Electro Optics
- Shipbuilding Technology Workshop
- World Aviation Conference
- NDIA Science & Engineering Technology Conference
- Automation in Shipbuilding Conference
- International Conference on Silicon Carbide and Related Materials

In addition, Navy ManTech and the COEs had thirty-two exhibit booths and displays at over twenty-five technical tradeshows and conferences.

c. Center of Excellence Newsletters and Reports

During FY03, Navy COEs published the following:

- Hard Copy Newsletters --- distribution 66,000
- Electronic Newsletters --- distribution 40,000
- Annual Reports --- distribution 10,000
- BMP Best Practices Survey Reports (7) --- distribution 12,600

The NJC also publishes a monthly Newsletter in the Welding Journal of the American Welding Society with a monthly circulation of 45,000 copies.

d. Navy ManTech Program Office Publications

The Navy ManTech Program Office distributes several technology transfer and informational publications during the year. These publications are distributed at various conferences and technical symposia as well as through electronic transmittals and mailings. A number of these publications are also available on the Navy ManTech Web site.

- Navy ManTech Project Books (CDs) provide users with detailed information on all active ManTech projects – 1,000 distributed.
- Navy ManTech Points of Contact Booklets provide information on the Program's Investment Strategy as well as key points of contact within ONR Headquarters and Detachment, the Systems Commands, and Centers of Excellence – 1,000 distributed.
- "How to Do Business with Navy ManTech" brochures provide detailed information to new ManTech customers on the mechanics of the Program – 500 distributed.
- "Shipbuilding and Ocean Technology, Asia-Pacific Region" newsletter distributed two to three times per year to approximately 200 individuals.
- "Navy Manufacturing and Industrial Program Report", Navy ManTech's quarterly bulletin, provides a description of current ManTech achievements and activities -- available through the technology transfer section of the Navy ManTech Web site.

8. ManTech Highlights

- **Warfighter, Impact, Weapons Systems, Sea Power 21, Transition, Challenges:**

  These represent the current guiding principles for ManTech in FY03 and the future. ManTech is employing these principles as it transitions from the traditional ManTech Program to the new investment strategy.

- **Navy ManTech is leaner and more responsive:**

  Following overall Navy / ONR guidance, during FY03 the ManTech Program reduced its Headquarters staff by 21%, reduced its contractor support hours by 39%, and reduced Program dollars supporting Systems Commands (SYSCOMS) ManTech Coordinators by 33%. Plans were also initiated to transfer the ManTech functions from the Philadelphia Office to the Headquarters staff. To accomplish this significant reduction, the following occurred:

  - Headquarters Program Officers assumed one or two additional COEs to manage and administer.
  - The contractor support effort was redefined to primarily provide engineering / technical support to the Headquarters Program Officers.

- SYSCOM support was refocused to supporting Headquarters Program Officers with technical oversight functions.
- COEs have been encouraged and empowered to manage their ManTech activities with less Headquarters involvement.
- To communicate more effectively, ManTech has initiated regularly scheduled meetings with the COE Directors.
- ManTech will continually review processes and procedures both in-house and at the COEs to assure the maximum amount of available dollars are applied to projects that support warfighter requirements.

- **New Navy ManTech COE:**

  The Center for Naval Shipbuilding Technology (CNST) was established in FY03 to support the Navy's on-going effort to develop advanced shipbuilding and repair technology. Near-term efforts are focused on DD(X), CVN 21, and Virginia Class submarine programs.

- **Joint Service Coordination:**

  The OSD sponsored Joint Defense Manufacturing Technology Panel (JDMTP) is the long-standing organization for coordination of the ManTech programs of the Services and the Defense Logistics Agency. In addition, the JDMTP provides a forum for interaction with other government agencies, including the Missile Defense Agency, the Departments of Energy and Commerce, and NASA, on manufacturing advancements and needs. Through an industry association representative, the JDMTP and its technical subpanels maintain a communication link to industry and obtain senior industry leadership assistance on the evaluation of broad manufacturing issues. During FY03, the JDMTP began the process of reassessing its charter to strengthen the long-term institutional support for ManTech. The Service ManTech Directors are currently evaluating crosscutting initiatives for potential joint service investments. The topics for assessment include data links, sensors (focal plane arrays), and batteries.

- **Looking Forward:**

  In addition to continuing efforts to reduce overhead functions and pursue joint service investments, in FY04, ManTech will:
  - Continue to implement ManTech's new investment strategy with the intent of incorporating two new platforms: Littoral Combat Ships (LCS) for PEO(Ships) and one for PEO(Tactical).
  - Investigate incentives and cost sharing opportunities for COEs and their subcontractors to ensure a smoother and more rapid project start to meet transition windows of opportunity.
  - Continue coordination with the FNCs with the intent of identifying additional high-priority investment opportunities.
  - Utilize the knowledge and experience of Asian shipbuilding practices gained by the returning ONR Asia staff member to assist in the development of ManTech shipbuilding investments.


NAVY
MANTECH
manufacturing technology program

APPENDIX

a. Abbreviations

Throughout this document, the following abbreviations have been used:

Abbreviation	Center of Excellence
BMP	Best Manufacturing Practices Center of Excellence
CMTC	Composites Manufacturing Technology Center
CNST	Center for Naval Shipbuilding Technology
EMPF	Electronics Manufacturing Productivity Facility
EMTC	Energetics Manufacturing Technology Center
EOC	Electro-Optics Center
GCRMTC	Gulf Coast Region Maritime Technology Center
iMAST	Institute for Manufacturing and Sustainment Technologies
NCEMT	National Center for Excellence in Metalworking Technology
NJC	Navy Joining Center
	Other Projects
LPW	Lean-*Pathways*
SPANS	Supply-Chain Practices for Affordable Navy Systems
3-D Printing	Electronic Based Manufacturing using 3 Dimensional Printing Metalworking Technology

b. ManTech Web Sites

The following table provides the Web addresses for the Navy ManTech Program, the DoD ManTech Program, and the COE Web sites:

Web Site	Web Address
Navy ManTech	https://www.navymantech.com
DoD ManTech	http://www.dodmantech.com
BMP	http://www.bmpcoe.org
CMTC	http://cmtc.scra.org
CNST	http://www.cnst.us/
EMPF	www.empf.org
EMTC	http://www.ih.navy.mil/emtc.htm
EOC	http://www.electro-optics.org
GCRMTC	http://www.gcrmtc.org
iMAST	http://www.arl.psu.edu/centers/imast.html http://www.arl.psu.edu/centers/reptech.html
NCEMT	http://www.ncemt.ctc.com
NJC	http://www.ewi.org/njc

c. FY03 Transitions and Accomplishments

The following table provides an overview of the Navy ManTech transitions and accomplishments in FY03.

Transition / Accomplishment	Background / Purpose	Navy Importance / Relevance
Completed the development and implementation of process technologies resulting in a reproducible production scale CL-20 explosives and propellants manufacturing facility capable of producing 50,000 pounds per year at ATK Thiokol.	The Army and Navy collaborated on projects to predictably, consistently, and economically produce CL-20. Under Army sponsorship, a process was optimized to produce CL-20 with greater than 99% purity at yields in excess of 90%. The Navy ManTech project focused on the crystallization of CL-20. The technologies have successfully transitioned to the full, optimized 500-gallon production scale.	The use of CL-20 has the potential to make weapons systems 25% more lethal at a lower cost. Candidates for use include Advanced Gun System (AGS submunition payload), Standard Missile, Low Cost Autonomous Attack System (LOCAAS), and Common Missile. CL-20 production cost reduced from about $420 per pound to about $315 per pound. For AGS, the cost avoidance for about 138,600 pounds from FY06 through FY10 is over $2.5M per year.
Fiber Optic Array Electrical Splice Technology transitioned to Advanced Deployable System (ADS) array fabrication at Raytheon Naval and Maritime Systems (Portsmouth, RI).	Complexity of assembly of piezo-electric hydrophone sensors to undersea cable was leading to high failure rates and excessive assembly costs. Touch labor reduced while maintaining performance and reliability by implementing an automated cable handling system, use of die-cut adhesives, and snap-on ring positioners.	Touch labor required for sensor attachment reduced 68% from 7.48 hours to 2.68 hours per sensor, a cost avoidance of $1.9M per year for 5 years. In addition, structural integrity and operational reliability have been improved.
A simulation-based scheduling algorithm for a new steel processing facility was transitioned to Electric Boat Corporation (EB). This model enables EB to optimize the production sequence for a short horizon (2-5 days) to maximize the productivity of the facility.	In existing shipbuilding operations, excessive, non-value-added time is spent in material movement, setup, and locating resources (crane, welder, inspection equipment, etc.). A detailed simulation model based on real data was created to visualize the facility, resources, and steel processing operations prior to construction and simulate tradeoffs. This project extended the simulation with scheduling capabilities enabling continuous benefit during facility operation.	To achieve cost reductions in the construction of Virginia Class submarines, EB has invested ~$12M in its new steel processing facility reducing man-hours significantly (proprietary). This scheduling model enables EB to maintain time savings as the facility workload increases by: 1) maximizing utilization of key resources such as plate marking and plate cutting machines, and 2) minimizing bottlenecks in the material handling operations.
Collaborative Work Environments (CWEs) and associated web technologies provide geographically dispersed teams with more effective/efficient state-of-the-art Web-based program management.	There is a pervasive need for effective communications. CWE provides a common, readily evolutionary/flexible set of tools to access information regardless of location or platform. It uses continuous product improvement processes to leverage technologies to address rapidly emergent program management communications requirements.	CWE leverages technology for effective communications and program management for key Navy/DoD programs (e.g., Defense Finance and Accounting Service (DFAS), Standard Missile-3 (SM-3), AEGIS BMD, and Defense Acquisition University (DAU)).

Transition / Accomplishment	Background / Purpose	Navy Importance / Relevance
Conducted curriculum development programs for composites repair at Naval Air Depot Cherry Point, Naval Air Station Oceana, and Naval Air Station Miramar.	Navy Aviation Repair Depots have had outdated repair and maintenance manuals for the inspection and repair of naval fixed and rotary wing aircraft. This project developed coordinated composites repair processes and associated training programs for aviation depot personnel.	These curriculum and repair development programs develop specific skill sets and requirements for naval technicians, both in the depots and in the fleet, to maintain naval aircraft.
MMIC Flip Chip (Current Project) - Accomplishments to Date - Transitioned technology - high rate foundry is now fully operational and supporting LRIP 1 deliveries. Second source foundry under development with completion scheduled in 2004. Target Transition in FY05 - X-Band MMIC Flip Chip Interconnect technology transitioning at LRIP 1 in the APG-79 AESA Radar for the F/A-18E/F.	Develop a high volume production capability with two manufacturers to support silver type MMIC Flip Chip bumping. Requirements are to: 1. Achieve a yield through bumping better than 85%. 2. Qualify RF Components commercial foundry. 3. Qualify a second source foundry.	The high rate silver bump process will lead to a projected $110K reduction in the unit price of the APG-79 AESA Radar for the F/A-18. Additionally, the high rate capability will support other DoD programs that require millimeter wave chip technology interconnect.
In April 2003, a full-scale, industrial-hardened working prototype of the Automated Paint Application, Containment and Treatment System (APACTS) was demonstrated at the Trident Repair Facility (TRF) in Kings Bay, GA. The APACTS has been proven to be effective at applying epoxy anti-corrosive, copper-ablative anti-foulant, and silicone alkyd freeboard paints with high transfer efficiency, excellent film thickness control, and near-100% overspray capture.	To preserve a domestic manufacturing and repair capability, the U.S. Navy needs to employ environmentally compliant hull painting solutions. Currently, paint overspray is routinely released to the environment and application of copper ablative antifoulant paints leads to substantial release of copper into inland estuaries and waterways. The APACTS is an environmentally compliant solution for applying paints to the underwater hull and freeboard areas of large ships in dry-dock without the need to erect expensive, negative-pressure containment structures around each ship.	Manufacturing benefits of APACTS accrue through elimination of containment structures and rigging (cost avoidance of over $1.4M/drydocking), substantial reduction of rework, and improved paint spray process control. In addition, coating thickness control is substantially improved which will beneficially affect the longevity of the coating system and will support extended dry-docking intervals.
Developed new powder metallurgical techniques (P/M) to manufacture near-net rhenium shapes and characterized and commercialized rhenium machining techniques.	The manufacture of thin-wall, precision components from basic rod, plate and other bulk shapes involves large amounts of costly machining. Elemental rhenium is rare and expensive, typically $2,000 per kg. It was therefore an ideal candidate for the application of near-net P/M manufacturing techniques. In addition, rhenium is difficult to machine using single-point cutting methods resulting in long manufacturing lead times for machined components. At the onset of the project, only a handful of machining vendors were experienced with the material, contributing to the delays and limiting the production capacity.	Powder injection molding (PIM), a method that is capable of complex shapes and maximizes material utilization, has been demonstrated for rhenium material. The PIM process was developed to the point of manufacturing hollow Standard Missile 3 (SM-3) thrusters suitable for hot fire testing. Alternative machining techniques were characterized, optimized, and passed on to U.S. tool and die shops and throughout the rhenium fabrication community. The end result: a nearly unlimited supply base of rhenium machining capability as well as new, alternative techniques for shaping rhenium to meet Navy missile system needs.

Transition / Accomplishment	Background / Purpose	Navy Importance / Relevance
Developed manufacturing process for high-strength marine-grade fasteners for Virginia Class submarines.	Reducing life-cycle costs for the SSN 774 Virginia Class submarine (SSN 774) and the next generation surface ships is of paramount importance. Reliable large diameter, high strength fasteners that meet stringent performance criteria and provide an extended period of service beyond that of the current generation of fasteners contributes to reducing these costs. Currently, bolts are changed out at periodic intervals to preclude catastrophic failure. This project developed manufacturing process parameters for manufacturing large diameter steel alloy MP-98T fasteners to achieve desired corrosion resistance and added strength and toughness.	New fasteners will result in reduced weight for the Virginia Class submarines, increased propulsor reliability, and reduced life-cycle costs due to reduced inspections and maintenance requirements. The new material is expected to last for the life of the submarine without mechanical or corrosion failures. The SSN 774 Virginia Class Submarine Program Office has identified a cost avoidance of $220,000 per year per subsystem. Using the fasteners for five subsystems (propulsor, advanced seal delivery system, dry deck shelter, high frequency sail array, and wide aperture array) as planned will result in a total cost avoidance of $1.1M per fielded submarine.
Implemented Lean-*Pathways* (LPW) methodology at five Northrop Grumman Ship Systems (NGSS) suppliers resulting in the avoidance of non-value added costs for out-year LPD 17 production.	Suppliers comprise up to 80% of the cost for the LPD 17. Shipbuilders need to address both process and business issues at supplier levels to achieve substantial improvements in cycle time, quality and productivity. Five LPD 17 suppliers were selected to participate in the program out of sixteen possible candidate companies based on the degree of benefit to the LPD 17 and the applicability to other Navy systems. The five suppliers now are in a position to share best practices and act as mentors to new suppliers.	Some results from this project include: 1) Heavy steel fabricator reduced blast / paint process by over 3,000 man-hours per year, kitting process by over 3,700 man-hours per year, and improved kitting accuracy by 78%. 2) Navy ball valve manufacturer reduced setup time by 50%, inventory by 27% and number of assembly steps from 11 to 5. Disassembly and reassembly of specific valve types eliminated during installation saving several thousand man-hours. The LPD 17 Program Office and NGSS continue to recognize the increased importance of supplier initiatives to impact overall product affordability resulting in a second phase initiated as an FY03 New Start.
F/A-18E/F nose landing gear critical path cycle time reduced from 62 weeks to 48 weeks as a result of SPANS Supply Chain Value Stream Management (SCVSM) Project. Costs were reduced by $30K per set of landing gear.	SCVSM applied LEAN values across the entire supply chain for the nose landing gear of the F/A-18E/F aircraft. LEAN intervention and Value Stream Mapping was accomplished at each supplier site. Then the supply network was examined as a whole to determine cross-network efficiencies in inspection requirements, batch sizes, and other macroscopic supply chain network issues.	Boeing's goal was to reduce the cycle time for the aircraft to 18 months at a total cost NTE $45M per aircraft. SCVSM is an important tool in reducing costs and cycle time for a key component supply network that was outside the desired 48 week cycle time for the particular component.
Supply Chain Dynamics (SCD) project for SPANS modeled an entire supply chain for the Standard Navy 525 Valve with Northrop Grumman Newport News (NGNN).	SCD demonstrated lower inventory levels could be maintained while maintaining a 99.9% service availability level. SCD ties in with the existing NGNN workshop models in order to demonstrate how individual workers can create the disruptive "bull-whip effect" through their own actions by drawing out too many parts over a prolonged period of time.	Lower inventory holding levels equate to less capital tied up in inventory. NGNN has committed to a less expensive carrier. SCD is one tool to reduce costs by testing the viability of differing supply chain options.

Transition / Accomplishment	Background / Purpose	Navy Importance / Relevance
Rapid Response / Rapid Insertion		
Rapidly identified a COTS solution for alternative connector systems for the MK8 Mod 1 SEAL Delivery Vehicle. Implemented by NSW Detachment, CSS Panama City.	Requested by PMS-Naval Special Warfare and the NSW Detachment CSS Panama City, Fl to examine potential connector alternatives that would ease manufacture and maintenance of the Computer Display Unit for the MK8 Mod 1 SEAL Delivery Vehicle. The purpose was to provide commercial connector alternatives to meet environmental and mission requirements.	Improved availability and reliability within the SEAL Delivery Vehicle through the integration of commercially available componentry. Specific benefits in system availability increase and cost avoidance are still being reported. This rapid response project is an example of Navy ManTech rapid insertion and resulted in an FY03 New Start that is cost shared by the SEALs.
Landing Craft Air Cushion (LCAC) Extrusion Seal, Rub-ring, and Umbrella valve new designs have been transitioned to the Life Cycle Manager -the Coastal Systems Station Panama City, FL, for incorporation into the fleet of LCACs.	LCAC lift fan bearings and seals were experiencing a short service life, contributing to high lifecycle costs and reduced availability for the LCAC fleet at ACU-4 and ACU-5. This was a NAVSEA Top Management Attention/Top Management Issues (TMA/TMI) Issue with "no Solution". This project purpose was to identify the cause of the LCAC Lift Fan Seal scouring and wearing on the fan shaft.	It is estimated that lifecycle savings of approximately $2.0M will be achieved by implementing the ManTech solutions provided. The result is simplified maintenance procedures, thereby enhancing readiness and availability.
This rapid response activity transitioned field welding repair technology for titanium to the XM777 Howitzer Project Office, the U.S. Marine Corps Logistics Base (Barstow) and Aberdeen Training School. The transitioned technology includes a repair tool kit of equipment and procedures for weld repair of titanium structures in support of field operations.	The titanium structure of the XM777 howitzer must be maintained in the field. Titanium weld repair procedures and trained personnel did not exist in the field or at the Marine Corps depots. The objective of this rapid response project was to support the XM777 Program Office and U.S. Marine Corps Independent Logistics Assessment Team in developing weld repair procedures for this weapon.	This project defined equipment, repair welding procedures, support facilities, and the skills necessary for successful field repair of titanium. An appropriate tool kit (e.g. equipment, procedures, filler metals, etc.) to make these repairs was identified. The probability of producing a sound weld repair has been increased, thus enabling a field repaired howitzer to return to active status more quickly.
Completed review of nanotechnology to determine manufacturing issues to enable transition. Conducted survey to understand the technology maturity, identify the potential for naval applications, identify potential manufacturing capability, determine Navy acquisition community interest, and establish recommendations for manufacturing technology investment.	The objective of this project was to develop an investment recommendation regarding the integration of nanotechnology into Navy and DoD systems. A maturity level matrix of the technologies that could meet system requirements was developed and is being used to establish recommendations for manufacturing capability to enable transition of the technology.	Nanotechnology has the potential to provide transformational performance increases in materials, sensors, and electronic componentry that will be used in Navy weapons systems. This has a pervasive impact across the Navy.

d. Sources of Outside Funding at Centers of Excellence

The following table highlights the sources of, the amount of, and the purpose of the OSF provided to the COEs:

Source of Funding	FY03 Funding	Purpose
BMP		
USN Chief Engineer (CHENG)	$130,000	BMP continues to support the CHENG in developing tools and policy for Interoperability and Integration of Systems of Systems and Family of Systems programs, FORCEnet, DoD Architectures, and Anti-terrorism/Force Protection (AT/FP).
NAVSEA/Force Protection NAVSEA 61T	$140,000	Knowledge base provided as a result of this effort will serve as a reference tool to determine potential threats and assess risks to ships and personnel in both domestic and foreign ports and provide methods to counter them.
Aegis Ballistic Missile Defense (BMD) PD 452	$392,000	MDA/Navy AEGIS BMD: As Aegis BMD transitions from a successful development program, including historic firsts in ship-based missile intercepts to a deployed defensive system, BMP continues its team role. Specific roles/accomplishments include: system-wide risk identification and mitigation, Systems Engineering (SE) support based on BMP SE model, producibility and transition to production guidance, Collaborative Work Environments (CWEs) to facilitate aggressive schedules/dispersed organizations, reliability and maintainability/test readiness/CM guidance for Navy's Pacific Missile Range Facility instrumentation radars to ensure functionality critical to flight test success, streamline business and administrative practices.
Standard Missile-3 (SM-3) (SM-3, formerly part of the Standard Missile Program Office, is now under Aegis BMD, renamed IWS 3A and funded as a separate project).	$500,000	Aegis BMD, SM-3 AEGIS LEAP Interceptor: BMP provides systems engineering support to ensure successful completion of critical flight test program with necessary reliability, maintainability, producibility and performance. BMP also supports longer-term transition to production efforts.
IWS 3A (Formerly the Standard Missile Office/PMS 422) PEO(IWS)	$1,065,000	BMP support to IWS 3A Program Office included: technical support on the new ERAM (SM-6) missile, production Standard missiles (including SM-2 Block 3 and closing of the SM-2 Block IVA), Vertical Launch Systems, NAVSEA Kinetic Warhead and the Standard Missile Change Control Board. Additionally, BMP led and launched a successful culture change initiative and a new highly effective TECHREP Office organization, now being considered to become an Echelon 3 level Navy organization.

Source of Funding	FY03 Funding	Purpose
Vertical Launching System (VLS) PEO(IWS) 3A32	$362,500	BMP provides systems engineering support to ensure that the new multi-missile VLS modules meet requirements, are safe, and developed at the least possible cost.
Multifunctional Information Distribution System (MIDS) PMW-101 and PMW-159 JPO	$233,000	BMP provides systems engineering, producibility, and risk management analyses for the Joint Program Office, LINK 16 community; and evaluates acquisition strategies and simulation as a tool for rapid introduction of technology. BMP has provided reliability and maintainability support for enhanced fleet availability and mission success. BMP has also performed on-site assessments on the maturity and capability of facility processes in each of the five participating nations. In addition, BMP has participated in drafting Statements of Work and Requests for Proposals for the JPO Joint Tactical Radio System that is proposed as the next LINK 16 generation communication device.
Missile Defense Agency, Quality, Safety, and Mission Assurance MDA QS	$100,000	BMP provides systems engineering support in several main areas: leading joint effort to define software development within new MDA contracts and how best to structure and assess existing programs, leading all parts and materials programs (including Diminishing Manufacturing Sources & Material Shortages (DMSMS) and obsolescence issues, electronics manufacturing issues, failure analyses, early warning database), developing a supplier road map to enable identification of critical supplier issues to provide mission assurance.
USMC Complementary Low Altitude Weapon System (CLAWS) Program	$147,000	Commander, MCSC contracted BMP to conduct a program assessment of CLAWS. The assessment spanned 4 months and was directed toward identifying the cost, schedule, and technical risks associated with proceeding to a Milestone C. BMP assessed these risks to CLAWS as it transitioned phases of the acquisition cycle to include risks associated with the technologies involved, the strategies chosen, and the contractor/industry capabilities to produce the final product for the Marine Corps in the timeframe envisioned. To complete this task, the BMP will draw heavily on its experience with industry in developing the BMP Database, its Systems Engineering Model and expertise, and its Producibility Guidelines Document (NAVSO P-3687). The work effort for CLAWS included meetings and discussions with other government agency offices, and its prime/subcontractors. This effort encompassed tours at contractor/ subcontractor facilities.

Source of Funding	FY03 Funding	Purpose
USMC Complementary Low Altitude Weapon System (CLAWS) Program - Training	$32,000	CLAWS Program contracted BMP to conduct Risk Management training for the Program Office, its engineering support contractor, the prime production contractor, and its subcontractors. BMP conducted a 2-day, 18 hour course in four Blocks as follows: Block I was an introduction of risk management, including a classroom exercise keyed to the CLAWS Program (this Block was taught by personnel from the Defense Acquisition University (DAU); Block II was an introduction/explanation of utility and use of the BMP Systems Engineering Model (SEM); Block III covered BMP's Program Manager's Work Station (PMWS) and hands-on use of these tools; Block IV was an explanation/ elaboration of the baseline TRIMS assessment provided by BMP in the CLAWS Program Assessment recently completed.
USMC Unit Operations Center (UOC) Program	$150,000	For the Commander, Marine Corps System Command (MCSC) and the UOC Program Manager (PM), BMP conducted a Production Readiness Assessment to evaluate risks associated with transitioning to full rate production. Evaluating the Government and its contractors' ability to exit the Low Rate Initial Production (LRIP) phase and go to full-scale production. Work effort included meetings/discussions with UOC Program Office, other government agency offices, and its prime/subcontractors. The principal efforts will be directed to analyses of the following: program organization; existing contractual arrangements; technical data package; Acquisition Strategy/Program Plan; existing contractor to meet program requirements and schedule within programmed costs; relationship between prime contractor and subcontractors with respect to quality assurance and process control, contractor management and manufacturing processes and risks in those processes; impact of GFE/GFI on production; schedule realism; readiness for Full Rate Production Decision; and programmatic risks associated with upcoming Operational Testing, Full-rate Production and Fielding.
Defense Finance and Accounting Service (DFAS)/Corporate Information Infrastructure (DCII) Collaborative Work Environment (CWE) DFAS-HQ/DIR	$125,000	BMP provides DFAS DCII with CWEs and associated Web technologies in a 4th generation BMP core competency.
ONR S&T to Production Project Code 36	$223,000	Provides outline of how to transition new technology to the fleet and war fighters quickly and effectively. These guidelines will ensure that technical capabilities are met.

Source of Funding	FY03 Funding	Purpose
ONR Future Naval Capabilities (FNCs) Collaborative Work Environment (CWE) Code 36	$95,000	ONR's FNCs team leverages BMP's CWE communications, technology and personnel to provide this collaborative tool for users across DoD and industry. ONR was able to leverage funding and state-of-the-art BMP technology that was developed in-house.
CMTC		
Naval Surface Warfare Center - Carderock Division	$241,302	Topology and Sizing Optimization of a Composite Advanced Sail for the Virginia Class Submarine. Mississippi State University is conducting topology studies to identify regions of the sail most suitable for placement of internal stiffeners that will result in maximized structural stiffness at minimum weight. Sizing optimization studies will then be conducted to minimize overall sail weight using skin thickness and stiffener areas as design variables.
EMPF		
ONR Code 362 - Industrial and Corporate Programs, Product Innovation Division, Technology Transfer	$201,000	The objectives of this program include the following: 1) Identify military applications and target specific Programs of Record for early insertion of Wide Band Gap (WBG) devices. Commercial specifications will be matched with those of the government system(s) and quantified with respect to what further development is required commercially so that those programs could eventually utilize Commercial Off-The-Shelf (COTS) technology; 2) Develop an implementation guideline for weapons systems by identifying commonalities and differences in thermal management for DoN mainstream high-end RF versus non-mainstream or non-RF applications. An alliance(s) with high-volume commercial users and producers of thermal management systems will be created; 3) Establish commercial partnership with high-volume commercial electronic packaging companies and leverage commercial packaging into DoD WBG systems. The benefit to the Navy is the identification of specific weapons systems that could benefit from advanced Wide Bandgap (WBG) devices. This will allow for the early insertion of these advanced RF devices.

Source of Funding	FY03 Funding	Purpose
Missile Defense Agency - Manufacturing and Producibility Technology Directorate	$200,000	The EMPF will be supplying the Missile Defense Agency (MDA) with a technical evaluation of available packaging technologies for phased array radar system transmit and receive (T/R) modules. The study will identify and describe the current packaging technologies applicable to T/R modules such as HDI and Flip Chip. Each pertinent packaging technique will be evaluated to determine the cost, producibility/reliability, performance and adaptability to meeting MDA radar needs. The information provided by the EMPF will assist the MDA in understanding the characteristics of the various available packaging techniques, and their applicability for utilization in phased array radar systems. The benefit to the Navy is the ability to assess risk and performance based on specific weapons system applications and packaging technologies for x-band solid-state transmit and receive modules.
DoD - U.S. Special Operations Command	$1,075,000	The SDV is a six-man wet submersible covert swimmer transport device that operates from surface or sub-surface ships to deliver a SEAL into regions without the knowledge of the local inhabitants. The current energy storage system is a high maintenance, high life cycle cost, mission impacting battery storage system based on Silver-Zinc [AgZn] technology. By taking advantage of the progress made in the DARPA projects and the commercial electric vehicle market, the U.S. Navy has the ability to refine the packaging aspect of these already developed energy storage cells to meet or exceed the needs of the U.S. Navy and U.S. Special Operations Command, U.S. SOCOM. The purpose of this project is to reduce battery acquisition cost, improve energy storage capacity and reduce the overall battery maintenance effort required to support the SDV.
U.S. Air Force Research Laboratory	$100,000	This was supplemental funding to an existing multi-year MEMS initiative by ManTech.
EOC		
PMA-272, Advanced Tactical Aircraft Protection Systems	$1,835,624	Advanced IRFPA Manufacturing
Missile Defense Agency	$3,838,000	Enhancement of High Power Laser Diode Arrays
Extrude Hone	$140,580	Rapid Atomic Plasma (RAP) Processing of WBG Material
NAVAIR, PMA202	$ 3,567,920	Intensifier Tube II dev & test EOC Labor
NAVSEA, PMS422	$1,786,000	Laser Assisted Ship Self Defense
ONR-313	$191,000	Piezo Electric Material
ONR-313	$1,215,000	Multifunctional Oxide Films

Source of Funding	FY03 Funding	Purpose
SIMMtec	$5,000	SIMMtec SBIR Phase I
Battelle	$525,000	Large Format Uncooled IR Sensors
ONR-313	$1,186,000	Micromachining
SOCOM	$1,480,800	Image Micro Sensors for Auto
Battelle	$ 200,000	SWIR
Brashear, LP	$2,000	Modeling Assistance
Marines Systems Command/Army NVL	$8,221,000	ANTAS/4 Follow-on EOC Labor
ONR-313	$681,000	MM Wave IR Sensor Development
DARPA	$1,430,000	Novel Crystal
Army PM FLIR	$2,059,000	Avenger FLIR Upgrade Development
ONR-313	$2,212,000	Panoramic Night Vision System
Boeing SVS	$30,000	Laser Lethality Study
Army	$1,317,000	National Center for Defense Robotics
NAVAL AIR WARFARE CENTER AD(PAX)--AIR 4.5.7	$2,130,000	High Speed FO Network Dev--develop photonic network components for naval aviation applications
DARPA	$6,800,417	Novel Crystal Growth
NAVSEA, PMS422	$4,540,000	E-O Tech for Ship Self Defense--requirements study for laser ship self defense
GCRMTC		
ONR STTR Program	$21,000	"Self Contained Actuation Systems"
Textron, Inc.	$20,000	"Reliability Analysis for a Diesel Engine Propulsion System"
ONR and NSWC- Carderock	$76,463	"Marine Composites Affordability - A Knowledge-based Approach"
ONR STTR Program	$11,480	"Affordability Measurement and Prediction Methods to Support Affordable Design of Ship Systems"
ONR	$47,285	"Technology Insertion Cost Estimation Comparison for Aircraft Carrier Systems"
ONR - DEPSCoR Program	$33,700	"Uncertainty Calculus to Minimize Total Ownership Costs for Ships"

Source of Funding	FY03 Funding	Purpose
iMAST		
Air Force Office of Scientific Research Aerospace and Materials Sciences (MEANS)	$125,000	AFOSR POLYMER MATRIX: Develop an analysis tool that will accurately predict the effects of variations in prepreg materials on structural performance.
Army TACOM-ARDEC	$225,000	Mo Shape Charge Liner Fabrication Process: Develop the fabrication processing of near shape Mo shape charge liners through development of high green compressibility Mo powders, evaluation of these developed powders using the Hydropulsor High Velocity Compaction process, and exploration of sinter, HIP, and cold or warm work processes to fully densify the Mo component.
Boeing Integrated Defense Systems	$200,000	Task 1.12 Composite Structural Housing - Part B: Implement acoustic tailoring to reduce radiated noise from the CH-47 forward transmission housing.
Electric Power Research Institute (EPRI)	$220,000	Technology Development for Shaft Crack Detection in Nuclear Power Plants: Technology development for shaft crack detection in rotating equipment in nuclear power plants, including primary coolant pumps, feed pumps/turbines, centrifugal charging pumps and condensate pumps using torsion vibration features as a diagnostic method and wireless technology.
Honeywell	$298,477	Spray Formed Alloys for Aircraft Wheels: Develop a new alloy to reduce weight and improve the performance of aircraft wheels.
Laser Processing Consortium (Bechtel Bettis Inc, Kennametal Inc., South Dakota School of Mines & Technology, Knolls Atomic Power Labs, etc.).	$52,500	Develop and implement advanced laser processing technology for members of the Laser Processing Consortium.
Marine Corps Systems Command NBC Defense Systems	$2,000,000	Multi-Sensor Analyzer/Detector (MSAD) Phase III: To expand the range of chemical vapors, interferents and biological agents and the associated CINET logic within the MSAD II/III processor; to complete investigation and development of a reproducible Surface Enhanced Raman Spectroscopy (SERS) detector using nonfabrication techniques and evaluate the SERS at ECBC; to further develop/refine the MSAD II/III prototypes to include CINET, the biological detection system (BDS) and SERS components.

Source of Funding	FY03 Funding	Purpose
Marine Corps Systems Command NBC Defense Systems	$1,378,348	Multi-Sensor Analyzer/Detector (MSAD) Phase II: To expand the range of chemical vapors, interferents and biological agents and the associated CINET logic to reduce false alarms; to develop a reproducible Surface Enhanced Raman Spectroscopy (SERS) detector using nonfabrication techniques and evaluate the SERS at ECBC; to further develop/refine the MSAD prototypes to include testing in increasingly demanding environments.
Marine Corps Systems Command BMADS Product Group	$200,000	Technical Support to MARCORSYSCOM Battle space: Provide technical support to Marine Corps Battle space Management and Air Defense Systems (BMADS) Product Group Directorate in the areas related to the development, test and integration of future radar systems and support equipment.
Marine Corps Systems Command Chief Information Officer	$220,000	Marine Corps System Command (MCSC) Integrated Data Environment Architecture Design: Continue a set of sequential tasks for the MCSC Chief Information Officer to develop functional and technical requirements for a command-level integrated data environment.
NASA - Engineering of Complex Systems (ECS)	$110,000	JPL-Des. Space Exploration: Apply the methods for concept design space exploration to NASA programs of interest. Develop methods to trace "Features" in system design space to their root cause in subsystems.
NAVSEA PEO(Subs) RT (CASP)	$300,000	Composite Advanced Sail Support: Develop the fatigue and flaw criticality protocol to support the implementation of composite materials for a lightweight SSN Sail.
NAVSEA PMS 395A24	$1,082,702	ASDS Spare Propeller Fabrication: Fabricate a spare composite rotor for the ASDS and qualify the rotor for N-year life.
NADEP Jacksonville (Code 6.3.1.5.0)	$90,000	Design, develop and install a modern control system for an existing wing fold test stand.
NRO - AS&T Director's Innovation Initiative	$350,000	Concept Design Space Exploration: Develop tool to visualize multi-dimensional trade space, in support of design space exploration.
ONR 353	$192,534	DN SERS SURF DES: Using nanofabrication technologies to develop production-viable processes for SERS surfaces, characterize the surfaces, assess process robustness, develop process design tools to allow repeatable production of surfaces specific to desired taggant chemical species, and validate the performance and reproducibility of the SERS surface generation processes.

Source of Funding	FY03 Funding	Purpose
ONR BOA - ONR 342CN	$709,643	Coherent Analysis Computing Environment (CASE): Development and demonstration of information recovery and dispersal systems for improvement of operational efficiency in aviation squadrons.
ONR BOA - ONR-333	$277,742	Undersea Weapons Design and Optimization: Develop design space exploration techniques unique to undersea exploration. This effort will improve techniques in executing design space trades early in the acquisition process.
South Carolina Research Authority (Composite Manufacturing Technology Center)	$363,150	Composite Manufacturing Technology for Marine Impeller: Develop and optimize VARTM processes to incorporate embedded acoustic treatments and improve as-fabricated dimensional tolerances for a full-scale composite marine impeller.
South Carolina Research Authority (Composite Manufacturing Technology Center)	$175,437	SCRA AAAV (EFV) Troop Ramp: Design and improve the manufacturing affordability of a structural variant of the existing AAAV (EFV) troop ramp door armor system by reducing part count and by employing single-step processing.
NCEMT		
U.S. Army TARDEC	$122,532	The Combat Vehicle Research Phase IV project will identify critical components of combat vehicles and develop alternative manufacturing approaches for testing and insertion prior to production of the vehicles. Phase IV is evaluating the gun pod elevation arm.
U.S. Army ARDEC	$99,597	The PAM Ti 6-4 Slab Surface Quality Improvement developed the plasma arc melting (PAM) process to produce rectangular Ti-6Al-4V slabs while minimizing surface imperfections and a process of directly rolling slabs into armor plate.
U.S. Army TARDEC	$125,000	The Advanced Metallic Army Bridging, Phase II project will develop a lightweight, rapidly deployable bridge design concept that utilizes advanced metallics and manufacturing techniques for the primary load carrying structure. Potentially beneficial bridge concepts will be considered for further development and prototyping to address detailed design analysis and production manufacturability. This manufacturing technology will be transferred to TACOM and government prime contractors.

Source of Funding	FY03 Funding	Purpose
NAVSEA 05R	$4,485,128	The Metallic Materials Advanced Development and Certification Project will provide RDT&E required for certification of new naval shipbuilding materials and technologies. The project will evaluate and certify new materials and selected processes that have potential for weight reduction, lower costs and/or increased performance.
Office of Naval Research Code 36	$349,980	The Titanium Metal Matrix Fabrication Technology Project supports the development of manufacturing procedures to insert Titanium Matrix Composites into Navy aircraft engines.
U.S. Army ARDEC	$399,999	The objective of the Low-Cost Titanium Development for U.S. Army Applications is to develop and demonstrate low-cost titanium PAM-only process casting and fabrication technologies for a wide variety of ground combat vehicles and reduce the weight for frames, appliqué armor and other system components.
U.S. Army TARDEC	$1,999,999	The Ultra High Performance Structures and Armor project will identify critical components of combat vehicles and develop alternative manufacturing approaches to reduce weight and improve the total affordability of combat vehicles.
U.S. Army TARDEC	$599,989	The Active Suspension Demonstrations project will redesign and fabricate road arms to facilitate the integration of an active suspension system into the Lancer Combat Vehicle. In addition, the project will procure the suspension system that will improve the handling aspects of the redesigned HMMWV trailer and use the trailer as a technology demonstration platform for FCS support vehicles.
NJC		
U.S. Army Armaments Research and Development Engineering Center, Picatinny Arsenal	$300,000	Development of welding procedures and welding process controls for titanium structures in support of the Army's 155mm Lightweight Howitzer procurement. The benefit to the Army is reduced acquisition and sustainment costs for this weapons system. This development effort leverages the Navy ManTech project in support of the Marine Corps LW155mm Howitzer acquisition program.
U.S. Air Force Research Laboratory, Wright-Patterson Air Force Base, Ohio	$25,000	Participation in a Group-Sponsored Project that examined causes and cures for weld porosity in thin-wall tubes. The work examined cleaning, shielding, and welding procedure variables and resulted in recommended best practice for welding tubing.

Source of Funding	FY03 Funding	Purpose
ONR - Force Protection Research PE0602123N	$18,605	This project transfers hybrid laser-arc welding technology to industry in support of Navy programs for development of laser-fabricated structural members. Hybrid welding combines laser and arc welding processes to overcome the limitations of laser welding to meet Navy requirements for properties and productivity. The goal of the laser fabricated structural members is to decrease weight, minimize distortion, and eliminate steps in the current process to produce "T's" for ship structures. This could have a major positive impact on the weight and cost of DD(X) and CVN 21 programs.

...meeting the needs of the warfighter.